Opportunities for Wind Power at Army Facilities

Army World Environment and Energy Conference

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American Wind Energy Association

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Wind Industry Overview

- Explosive growth between 1994 and 1999 at 32% per year. 25% annual growth projected through 2009
- Projects are operating at greater than 35% capacity factors at good wind sites
- Over 98-99% availability
- Select projects are delivering **~3 cents/kWh** contracts (including Production Tax Credit)

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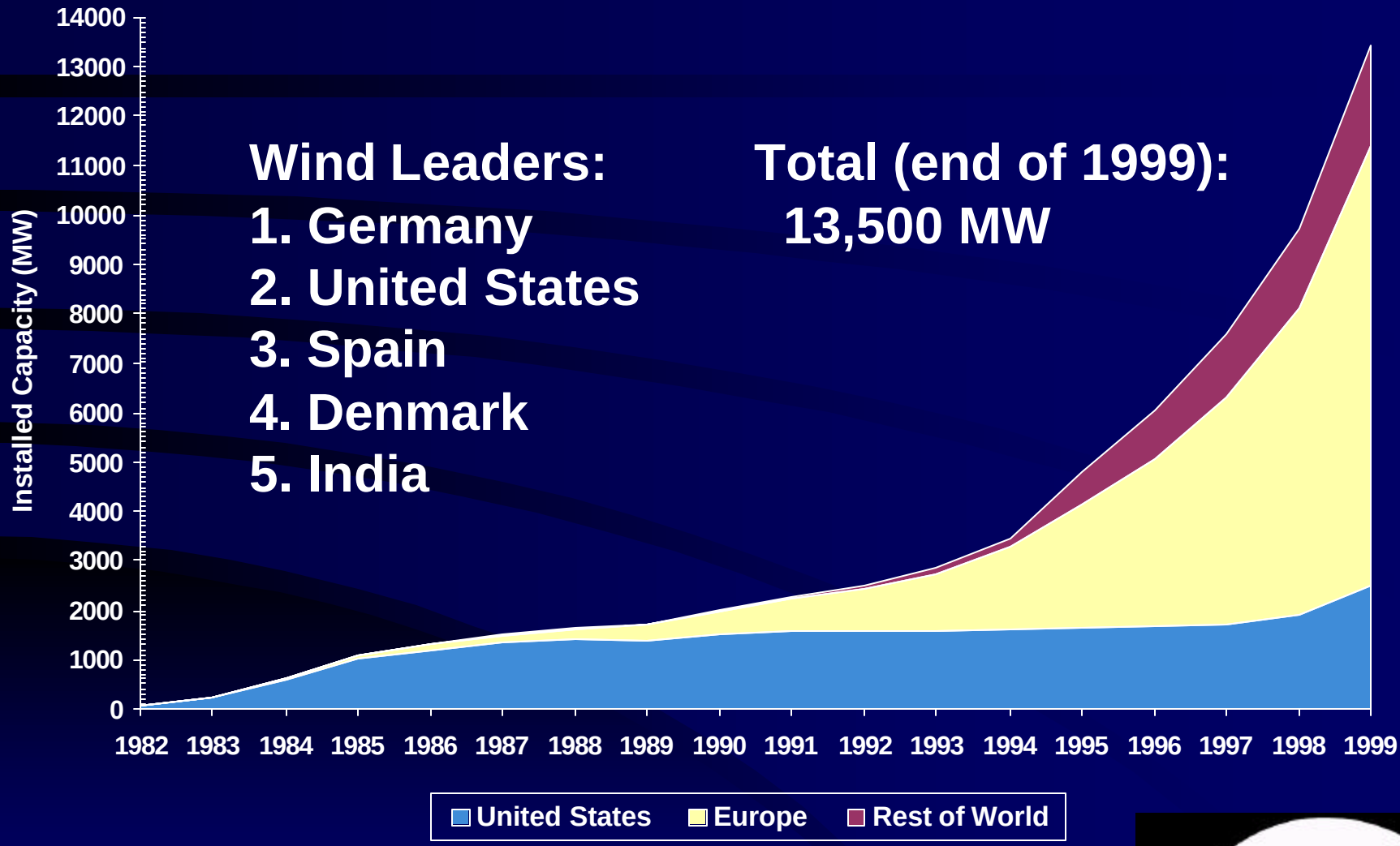
Wind Power Taking Off Worldwide



Wind Leaders:
1. Germany
2. United States
3. Spain
4. Denmark
5. India

Total (end of 1999):
13,500 MW

Based on information supplied by International Energy Agency.

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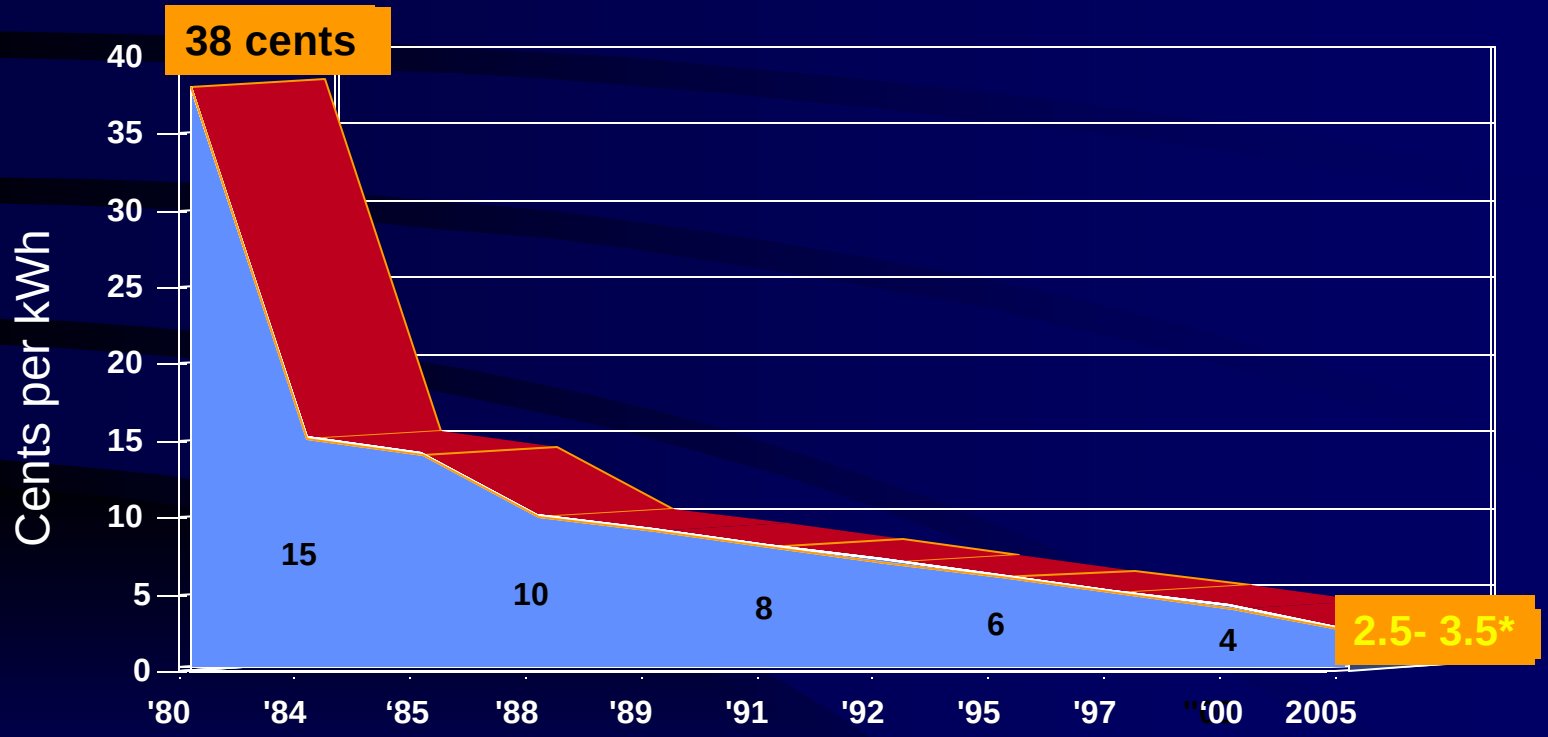
Wind Energy Cost

Cost of Wind-Generated Electricity 1980 to 2005

Levelized Cents/kWh



•Assumptions: Levelized cost at excellent wind sites, large project size,
•not including PTC (post 1994)

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Cost Drivers

- **Wind resource**
- Size of project
  - Transaction and mobilization costs are substantially fixed
  - Smaller projects cost more per unit of output
- Financing and power purchase terms
  - Surety and term of power sale

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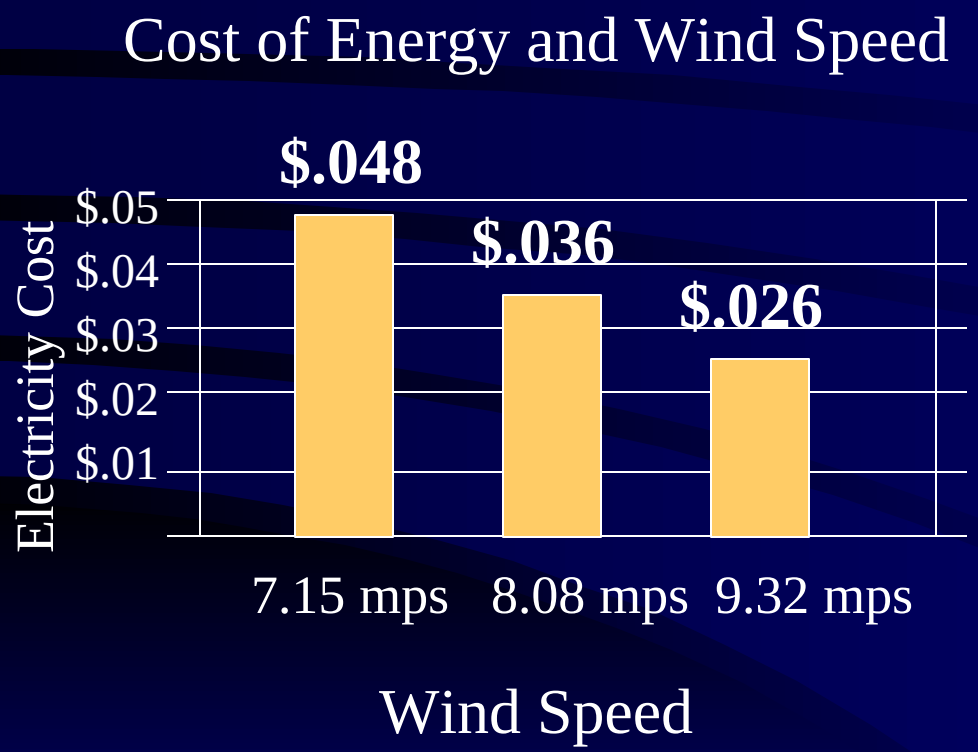
Wind Resource



Assuming the same size project, the **better** the wind resource, the **lower** the cost

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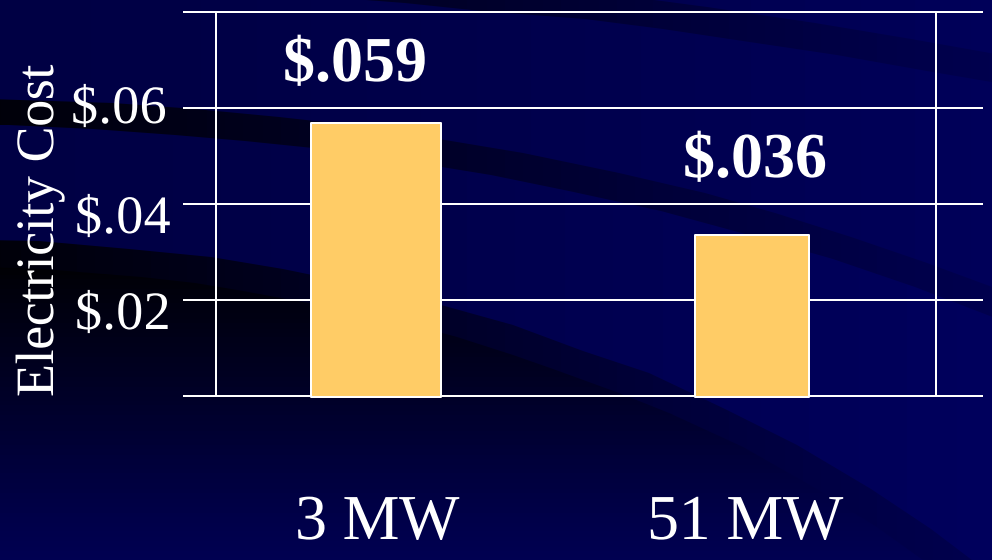
Project Size

Cost of Energy – Large Wind farm v. Small



Assuming the same wind speed of 8.08 M/S, a large wind farm is more economical

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Advanced Technology and Scale Economies Drive Down Cost

	1981	2000
Rated Capacity	25kW	1,650kW
Rotor Diameter	10 meters	71 meters
Total Cost ($000)	$65	$1,300
Cost Per kW	$2,600	$790
Output, MWh/year	45	5,600

120 x the energy at
20 x the cost!

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Driving Costs Down Further

- Advancements in turbine technology
- Project financing improvements
- Increasing project sizes

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Barriers to the Army's Greater Use of Wind Power -- Operational

- Potential interference with facility mission
- Extensive permitting requirements
- Limited information on wind resources
- Lack of incentive for base commanders to front costs for resource studies, etc.

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Barriers to the Army's Greater Use of Wind Power -- Financial

- Army bases often have negotiated very low rates for power
- Facilities often operating with fixed or declining budgets, especially for energy purchases
- Construction and Operating budgets are separate
- Most efficiency savings are owed to ESCO's or revert to headquarters for reallocation (rather than remaining at the installation level)

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Opportunities for Wind Power to Serve the Army's Mission

- Attain emissions-reduction goals
- Diversify fuel portfolio/reduce fuel price volatility risk
- Save money

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Emissions Reductions

- Reduced Greenhouse Gas Emissions

  One project the size of the San Clemente Island project (3 225-kW turbines) displaces almost 3 million lbs of CO2 per year.

- Reduced Air Pollution

  That 675 kW project would displace

  – almost 10,000 lbs of NOx per year
  – 15,000 lbs of SOx
  – Particulate matter air pollution
  – Mercury fallout

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Reduce Fuel Price Volatility Risk

- This summer, gas prices rose from about $2.15 Mcf to over $5 Mcf
- The vast majority of new electricity generation is expected to natural gas-fired, increasing demand pressure
- Continued tight electricity markets are likely to contribute to high and increasingly volatile electricity and natural gas prices*

*from analyst Matthew R. Simmons

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Cost Savings

- Where the **price of fuel** currently used is high
- Where the **wind resource** opportunity is good

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Recommendations

1. Install small-wind systems in off-grid, remote applications to save on diesel fuel purchase, shipping & storage costs
2. Contract with private developers to construct wind plant on base
3. Contract for long-term power purchase from wind plant development near base

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Recommendation #1– Army generates

- In places where Army is generating power, *especially off-grid, remote applications*

Purchase small wind systems from supplier

Small Wind Turbines Should be Considered When:

- **The Grid Must be Extended More Than 1 km (0.62 miles), or**
- **Costs of Conventional Power Exceed 20¢/kWh,**
- **Annual Consumption Exceeds 200 kWh, and**
- **Wind Resources are 4.4 m/s (9.8 mph; DOE Class 1) or Better**

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Why Small Wind?

- **Lower Life-Cycle Costs (nearly always)**
- **Lower First Costs (sometimes)**
- **Reduced Operations and Support Burden**

CH-46 Delivering Fuel and Water, East Timor

~ $5,000 per hour

Bergey 1.5 kW Delivering Water (120,000 l/day), West Timor

~ $5,000 one time

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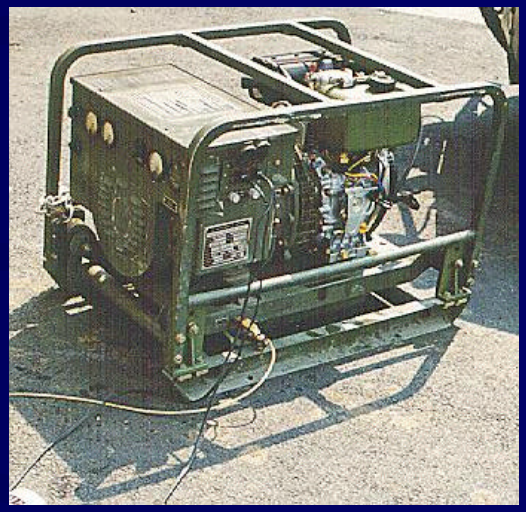
Diesels are Great, but …



- DoD: 83,100 Mobile Generators
  - Value of "fleet" exceeds $1.4 billion
  - Average age is 15 - 24 years (smallest units are oldest)
- 64,000 (77%) Fielded by U.S. Army
  - 40,800 (64%) are 5 kW or less
  - Surveys show ~ 50% are operated at < 20% load
  - Surveys show 60-70% of maintenance problems are due to "wetstacking", caused by generator underloading
  - Haiti experience: Only 89% operational readiness
- Healthy appetite for fuel … logistics and storage
- These problems mirror the problems we have seen, and remedied, in thousands of non-military remote power installations.

Hybrid Systems

Data supplied by PM-MEP

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Small Stationary Systems

- Misc. remote DoD facilities for training, communications, monitoring, etc.
- Wind attractive almost anyplace fuel is flown in

- Mostly new construction - retrofits have occurred, but with significant non-DoD funding

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Navy TACTS Platforms

3 Platforms 60 Miles off Savannah, Georgia

- **Equipment:** 2 x BWC 7.5 kW Wind Turbines, 5 kW Solar, ~ 100 kWh Battery Bank, 15 kW Diesel
- **Performance:** ~ 60 kWh / Day at 120 VAC
- **Customer:** U.S. Navy
- **Installation:** First unit Nov. 1993. Remaining five Nov. 1997
- **Results:** Almost no diesel usage. BWC wind turbines now being added to other TACTS sites.

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Recommendation #2 – Build On Army Land

Private Sector Builds on Army Bases

- Project construction and operation would be at the expense of the independent power producer
- Landowner royalties or revenue-sharing could offset any initial cost increase
- Wind turbines' visibility may be a negative and/or a positive

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San Clemente Island, CA

- U.S. Navy island 53 miles off San Diego
- Average demand 850-950 kW
- 3 225-kW NEG Micon turbines installed

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Ascension Island

- U.S. Air Force installation on British island in mid-Atlantic ocean, built in 1996
- Generated 351,000 kWh in the first month and a half of operation, displacing 28,000 gallons of diesel fuel
- Fuel savings expected to fully pay for installation in eight to nine years -- “free” power for remainder of 25-30-yr. life

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Recommendation #3 – Long-Term Purchase Agreement

- Purchase Wind Energy from an Energy Service Provider or from a Wind Developer
- Can take advantage of best wind resource sites
- Permitting can be accomplished more quickly
- Currently, only available in states that are in the process of deregulation

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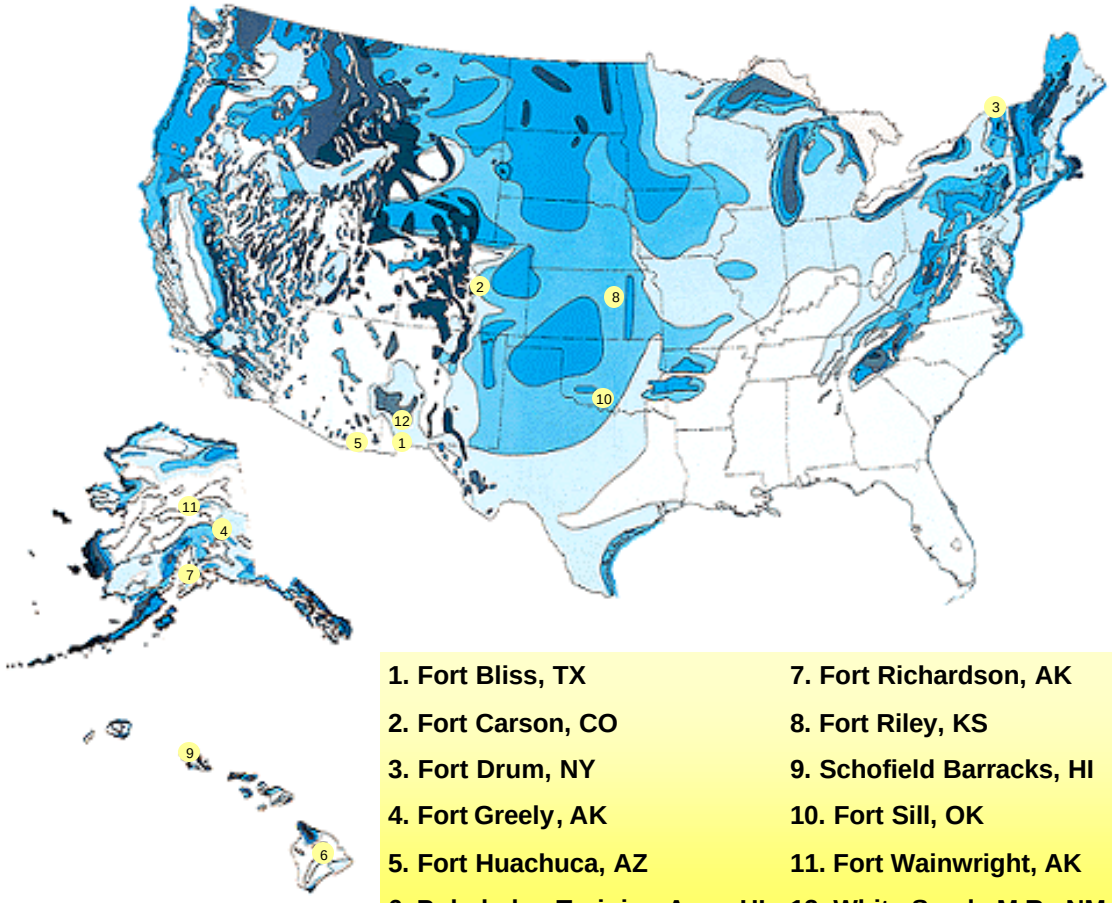
Opportunity



1. Fort Bliss, TX	7. Fort Richardson, AK
2. Fort Carson, CO	8. Fort Riley, KS
3. Fort Drum, NY	9. Schofield Barracks, HI
4. Fort Greely, AK	10. Fort Sill, OK
5. Fort Huachuca, AZ	11. Fort Wainwright, AK
6. Pohakuloa Training Area, HI	12. White Sands M.R., NM

Wind Resource for Army Windfarms

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Want to Know More About Wind Power?

Contact the AWEA Web Site or Email address at:

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